ABSTRACT OF THE DISCLOSURE

Noninvasive, MR-compatible methods and systems optically detect mechanical cardiac activity by anatomic (e.g., esophageal) movements. Most preferably, esophageal motion is detected optically and is indicative rhythmic cardiac activities. This esophageal motion may then be detected and used to provide a signal indicative of periods of cardiac activity and inactivity. The signal may be further processed so as to generate a trigger signal that may be input to a MR scanner. In such a manner, MR microscopy may be accomplished to acquire information at a specific phase of the cardiac cycle, for example, in synchrony with periods of cardiac inactivity. Moreover, since mechanical cardiac activity is detected and employed, instead of electrical activity as is employed in conventional techniques, the present invention is immune to electromagnetic interference during MR microscopy. As a result, robust cardiac signals may be monitored and gated during 2-dimensional and 3-dimensional *in vivo* microscopy. The present invention is therefore especially well suited for MR microscopy of small animals, such as laboratory mice and rats.